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Involucral-bracts 2-seriate, equal, obtuse; achene small ($2\frac{1}{4}^{mm}$).
13. *T. mexicana.*

d. Achenial hairs long, slender; their branches long and circinately rolled downwards; heads ¾ inch broad; pappus of very long bristles (11^{mm}), thickening at base; plant depressed, acaulescent, glabrous.
14. *T. wilcoxiana.*

e. Achenial hairs obtuse, entire when young, afterwards 2-lobed; plant branching from root; head short-pedunculate, mid-sized; achenes short ($2\frac{1}{2}^{mm}$); leaves narrow-spathulate. 15. *T. Watsoni.*

f. Achenial hairs simple or bifid, the lobes acute; heads mid-sized, peduncle mostly naked.

Leaves cauline, linear, or the lowest sub-subspathulate, acute or acuminate; involucral-bracts linear-lanceolate. 16. *T. florifer.*

Leaves radical, spathulate, their limb mostly broad and short; heads on short scapes; involucral bracts somewhat broad-lanceolate.
17. *T. scapigera.*

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THE HIBERNACULA OF HERBS.

BY AUG. F. FOERSTE.

IN the fall of the year, as the weather grows colder, the production of the normal leaves of trees is suddenly checked. They wither and fall off. Instead of them we find a close, compact cluster of scales, and within these a number of young leaves and sometimes flower-buds. These scales are designed to protect the young leaves and flowers from the cold during winter; they are therefore called the *hibernacula* or winter quarters of the tender parts. Towards spring the growth of the inclosed leaves and buds is very rapid, so as to burst open their coverings and allow a speedy development of the floral organs. Hence most trees possessing scaly buds flower early in the spring of the year.

It may not be as well known, however, that it is not at all uncommon for the earlier flowering, perennial herbs to possess hibernacula, or winter buds, containing the flowers of the following year; and that many of them owe the power of early developing their flowers to this fact. On the study of a great variety of herbs belonging to all classes of flowering plants, during the winter months, it became evident that such cases were by no means rare. Such a study may reveal also many other interesting facts as the following pages will show.

Perennial herbs, on the approach of winter, die down to the surface of the ground. The stem still remaining beneath the earth is called the subterranean stem, and furnishes the buds from which the next year's growth is developed. These buds may be either terminal or axillary. If they be axillary the terminal bud will not grow up into a flowering stalk, but will continue its growth beneath the surface of the earth ; only the axillary buds along the stem will form the flowering branches from year to year. The result will be that the entire subterranean stem, which remains after the decay of the aerial stems on approach of winter, will have been the product of the single evolving terminal bud. Such a stem is called a monopodium.

Claytonia virginica L., has a hibernaculum composed of the dilated bases of petioles, which in early spring give rise to linear-lanceolate blades. Enclosed by the bases of the petioles during winter are the diminutive racemes which in spring elongate, show two opposite leaves toward their base, and stand in the axils of the now fully developed single leaves. The flowering branches are axillary and the growth is monopodial. In early spring several specimens were found in the frozen earth which had already begun growth.

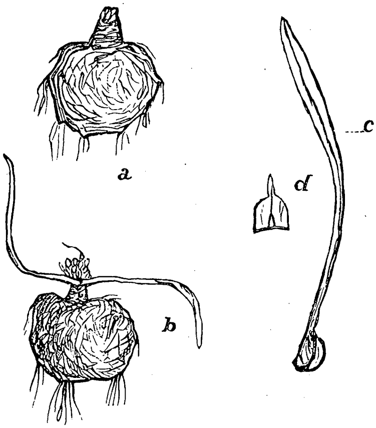

FIG. 1.—*Claytonia virginica*. *a*, plant in autumn; *b*, plant in February; *c*, leaf with broadened base; *d*, inflated base of undeveloped leaf.

On what do these plants live during the time they are encased in the frozen ground and still persist in growing? Evidently on the nutriment collected the year before within the tissues of the corm-like root. The rootlets are extremely few and small, and are generally arranged in dots on one great vertical circle about the so-called corm. When the nourishment has been withdrawn for the maturing of the plant, these little roots begin to lay up the store of food for next year's growth, and apparently it takes them all the year to do this. By autumn another bud is formed, which depends for its food not on the little rootlets, but on the store of food which they have accumulated.

Many other plants which have access to similar reservoirs of food, grow during seasons when the earth certainly cannot supply nourishment. *Thalictrum anemonoides* Michx., *Isopyrum biterna-*

tum Torr. & Gr., *Cardamine rhomboidea* DC., and *Erigenia bulbosa* Nutt., may be readily discerned beneath the fallen autumn leaves during the last days of January; and all of these have resource to food secured the previous year.

Trillium sessile S., is also a monopodium. The hibernaculum in this case is very highly developed, and encloses not only the perfect plantlet of the following year, with leaves, sepals, stamens and ovary, but also a little convex bud, from which the aerial stem two years hence is to develop. In the first week of February a plant hewn from the frozen ground, three inches beneath its surface, showed the leaves already protruding from the hibernaculum. Slowly this growth continues, perhaps only on warm days, until its proper season, April, arrives. The entire plant is then only an enlargement of the miniature already extant in autumn.

Uvularia grandiflora Smith, another of the Liliaceæ, has linear, oblong winter buds, which contain the aerial stems with their branches, the leaves and the terminal flowers all in a state of high development. They certainly contain a greater mass of detail than any other known hibernacula of herbs.

The winter-bud of *Asarum canadense* L., is very simple in structure, containing two leaves and a flower, enveloped by the loose scales, or specialized leaf-blades.

Anemone hepatica L., has a monopodial stem which produces no aerial branches; on this account the plant is said to be stemless. The bud consists of three small scales and three to four larger ones, the latter subtending each one flower bud. Within are seen three to four poorly developed leaves, which are very hairy.

Symplocarpus fœtidus Salisb., resembles the Anemone in having no aerial branches. A number of scales, showing by their variations that they are specialized petioles, are followed by a large number of leaves. The inner scales alone bear flowering spathes capable of development. However, almost all the earlier leaves contain in their axils abortive spathes, pointing to a probable summer flowering ancestor which could utilize them all. Both the Anemone and Symplocarpus have their flower buds highly developed, and being placed in the lower axils separate from the leaves, they receive the first nourishment and hence appear before the leaves. It is not unusual to find flowers in the first half of February which have mistaken the warmth of a few days for spring.

Arisæma triphyllum Torr., was observed by Mr. W. B. Werthner, who has taken great interest in the study of hibernacula. I quote his observation in the lines following:

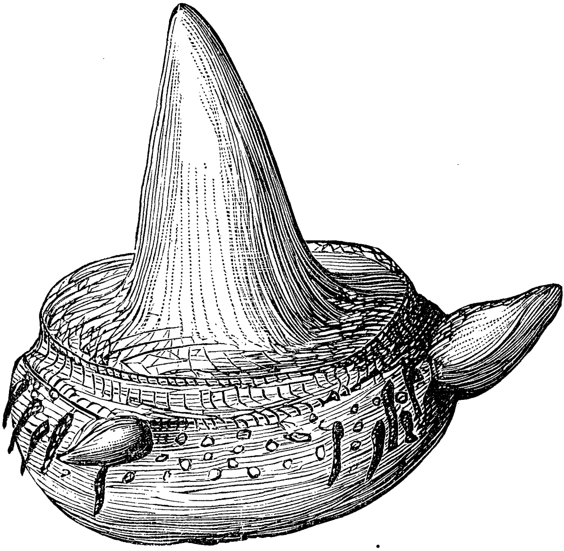

FIG. 2.—*Arisæma triphyllum;* top of bud two inches below surface of ground in February.

"The corm has several lateral buds, and is covered with a brown shredded husk, probably the base of last year's petioles. Within this coat are several thin membranous sheaths covering the whole bud, without seam or opening. The next two 'scales' are fleshy, each united so as to form a complete coat. The next sheath, fleshy too, is partly open at the apex, and overlapping, while the following one, continuous at the base, is convolute for about two-thirds of the upper part. There is then a sudden transition from bud covering to leaves and flowers. The flower bud is of almost the same size as the leaves. The spadix at this stage already plainly shows the ovaries, but of stamens no trace is found. At the base of the flower stalk is seen the bud for the *second* year's growth."[1]

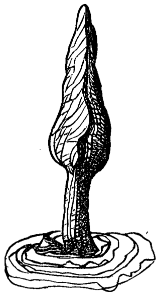

FIG. 3.—*Arisæma triphyllum;* flower bud with convolute spathe, and bud for next year's growth.

Sanguinea canadensis L., is another plant which contains the flower bud in the hibernaculum formed in the autumn. The specimens examined in the beginning of February had already commenced growing in spite of the frozen condition of the soil. The only way of insuring the condition of a hibernaculum before growth is to collect the herb in October or November.

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[1] The scales composing the hibernaculum of the Indian turnip may be considered as the modified sheathing petioles of leaves. The winter buds of the Arisæma and of a species of Trillium were discovered by Mr. A. P. Morgan, of Cincinnati, who communicated the fact to me.—*A. F. F.*

The winter buds of *Dicentra cucullaria* DC., are surrounded by the enlarged bases of last year's petioles and by numerous small granules disposed on branches which often terminate in a leaf-bud. This would indicate that the granules are also bases of petioles which were arrested in their development early in life and specialized for the purpose of retaining the food which shall permit the plant to grow while the soil is still frozen. The hibernaculum contains the entire plant in a high state of development, forming a pretty sight even at this stage of growth.

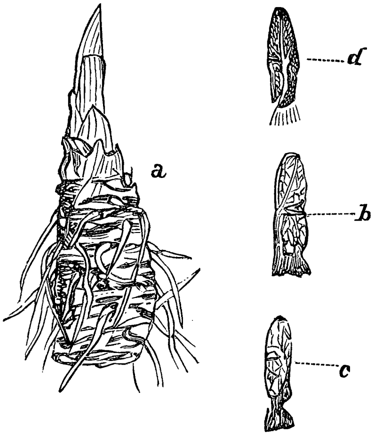

FIG. 4.—*Sanguinaria canadensis; a*, hibernaculum; *b, c, d*, leaves enwrapping flower bud after removal of the scales.

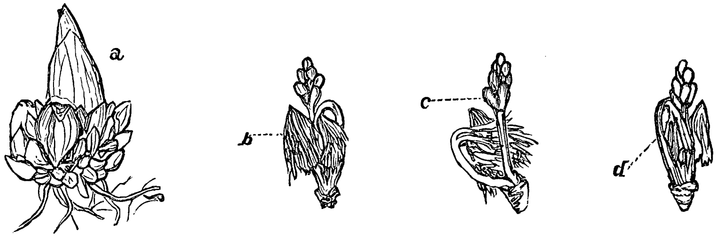

FIG. 5.—*Dicentra cucullaria; a*, tuberiferous bulb with hibernaculum (scaly bud); *b, c, d*, two leaves and raceme of flower buds after removal of the scales.

Earlier in this paper the formation of monopodial stems was described. In conclusion it may be well to note the formation of its opposite, the sympodial stem, or sympodium.

In certain plants, after the stem is of sufficient age to produce flowers, this office is undertaken by the terminal bud, which develops into an aerial stem for this purpose. When autumn arrives this decays, and it is evident that the continuance of growth must depend upon the development of the axillary buds. Next season these buds flower and their terminal parts are also killed down to the surface of the ground. Here again growth becomes restricted to the axillary buds on these axillary branches. This continues from year to year, so that one branch is continually being placed upon the other, and each branch becomes limited to one year's growth. And when the result is an apparently continuous stem it is called a sympodium. *Polygonatum giganteum* has a sympodium. The stem of *Jeffersonia diphylla* Pers., is the product of the same sympodial development. The hibernaculum consists of a number of scales followed by a number of leaves, in the center of which, terminating the stem, is the flower-bud. This alabastrum is so highly developed as to have the complete advantage of the leaves, insuring its appearance and anthesis before the leaves have received sufficient nourishment to force their way to the air. In this way a similar result is produced to that noted in Anemone and Symplocarpus, where the placing of buds in axils beneath the leaf-bearing internodes, causes a like appearance of flowers before leaves.

Summary.—The list of plants has now been sufficiently extended to note the principal characters of hibernacula among perennial herbs.

The winter-buds of herbs consist of scales which owe their origin to different parts of leaves (blades, petioles)[1] as in trees. They never attain the indurated character nor the resinous properties of scales in arboreal vegetation, but like them are sufficiently protective to enclose the leaves and flowers of the following year and preserve them from the effects of a sudden change of weather. Unlike the hibernacula of trees, the inclosed parts begin to grow early in winter, and often break the bounds of their enclosures to develop and push their way up through the frozen soil. They are enabled to do this by the supplies of nourishment furnished by subterranean reservoirs in the shape of thickened stems or roots. The existence of such winter-buds, containing the flower-buds of the next season, is by no means rare.

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THE HAIR-SAC MITE OF THE PIG.

ABSTRACT BY PROF. R. RAMSAY WRIGHT.

IN view of the discovery of the hair-sac mite (*Demodex folliculorum*) in the pig in America, a synopsis of Dr. Csokor's paper may be of interest.

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[1] The scales which envelop the sympodially arranged bud of *Geranium maculatum* are evidently dilated stipules.